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Case report

Management of humeral fracture nonunion in severe osteoporosis by a combination of locking plating and intramedullary fibular grafting

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ABSTRACT

Nonunion of the humerus in a severely osteoporotic bone is a likely event especially if the fracture is transverse. The management of such a combination is a challenge. Most of the conventional fixation methods are unlikely to succeed as the bone failure precedes implant failure in osteoporosis. The challenge is further compounded in severe osteoporosis when the cortical thickness is affected more severely. We used a combination of an intramedullary fibula with a locking plate in 5 cases. The results show that it may be a good combination in such situations as the bone strength is augmented and the plate pullout is less likely.

Introduction

Osteoporosis is defined by the WHO as a bone mineral density (BMD) of 2.5 standard deviations or more below the young normal mean. On this basis 26 million people in America are osteoporotic.[1,2]

Most of the fractures in the osteoporotic individuals occur in the proximal humerus, distal forearm, vertebrae, pelvis, hip and tibial condyles. However diaphyseal fractures are also common. With nearly 120,000 osteoporotic humerus fractures occurring annually, it is important to understand the methods of treatment and indications for such treatments of these fractures.[3,4]

Nonunion of the humerus is an uncommon complication of diaphyseal fractures. Its reported rate in the literature is quite variable, ranging from 1% to 10%.[5,6] It can be successfully managed by various surgical methods with the principles being open reduction, freshening of edges and stabilization using plate and screws, interlocking nails, or an external fixator.[7]

Nonunion in the osteoporotic bone is an even bigger surgical challenge as the degree of osteoporosis increases during the period of immobilization and can complicate osteosynthesis significantly. Locking plates are quite useful in the management of fractures of the osteoporotic bone. Reports about the management of nonunion of the humeral diaphysis in severely osteoporotic bone are uncommon.

The purpose of this study is to highlight the use of a combination of a locking plate and an intramedullary fibula in the management of nonunion of the humerus in a severely osteoporotic bone.

Case report

We included 5 patients in the study due to the relative rarity of this type of combination in patients. The average age of the patients in our study was 57 years (range, 51–67). There were three females and two males. Three patients had involvement of left humerus and two of the right side. All the patients had a midshaft involvement and radiologically the nonunion could be classified as atrophic. All patients had mild pain, tenderness and gross abnormal mobility at the nonunion site, and limitation of activities of daily living. All patients had stiffness of the shoulder and elbow to varying degrees. All patients had undergone a trial of conservative treatment initially. The average delay at presentation from the time of injury was 14 months (range, 12–18 months). Preoperative disability of arm, shoulder and hand (DASH) score averaged 84 ± 5 (range, 79–91).

The preoperative assessment included a dual energy X-Ray absorptiometry (DEXA) scan and a radiogrammetric measurement of

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the humerus for osteoporosis assessment. All patients had a T score below −3.5. However we were aware that disuse would have worsened the condition of the humerus even further. Therefore we used simple radiographs to assess the osteoporosis at the local level. We added the thickness of the two cortices and divided it by the width of the bone at a relatively unaffected level of the humeral diaphysis. In all cases this measurement was less than 31%. The five cases had been operated on at least once with an average of 1.2 (range 1–3 times).

All patients underwent surgery under general anaesthesia after administration of prophylactic antibiotics. The fractures were exposed through an anterolateral approach. Fracture fragments were freshened and debridement carried out until bleeding bone ends, and the medullary canal were exposed. Both fragments were then reamed progressively using serial hand reamers gently to open the canal for the placement of the fibula.

The mid-shaft of the fibula was harvested and shaped to fit the medullary canal. The procedure should be done meticulously to avoid postoperative discomfort. The length of the fibula harvested was equal to the length of the plate that was planned to be used preoperatively. In all the females, the graft had to be split longitudinally. The graft was slid up the medullary canal of one fragment and then slid backwards down the other fragment after the fragment was held in slight distraction in an aligned position. The two fracture fragments were then telescoped over the graft into a stable position.

Osteosynthesis across the fracture site was achieved by using locking plate and screws. We used 4.5 mm locking compression plates in all the cases. At least three screws on each side of the fracture were used. The remaining excess pieces of fibular graft were packed longitudinally bridging the fracture site. None of the patients had iliac crest bone grafting.

All patients were protected in an arm sling for a period of three weeks after the surgery. Elbow and shoulder mobilization was initiated carefully and under supervision after three weeks. Lifting of weights using the operated limb was deferred for a period of three months or until osseointegration of the fibular ends or fracture healing.

At final follow-up, the patients were assessed clinically and radiologically. Fractures were considered united if at least three of the cortices on radiographs showed evidence of bony trabeculae crossing the fracture site.

All fractures had solid clinicoradiologically evident fracture union by the six month follow-up. This was assessed when 3 of the four cortices on seen on 2 plane radiographs showed bridging. There were no wound problems. The average arm shortening was 2 cm (range, 1–3 cm).

The duration of follow-up was from 12 to 36 months. None of the patients had pain over the fracture site and the DASH score at the last follow-up averaged 27.

Interestingly 2 patients complained of some amount of discomfort at the graft harvest site in the immediate postoperative period only due to peroneal muscle movement. One patient continued to have significant stiffness of the shoulder at final follow-up. In the other four there was an average loss of 15° abduction and 5° flexion of the shoulder. There was minimal restriction in shoulder rotation at final follow-up in these four cases. All the patients had a full range of motion at the elbow at final follow-up (Figs. 1–4).

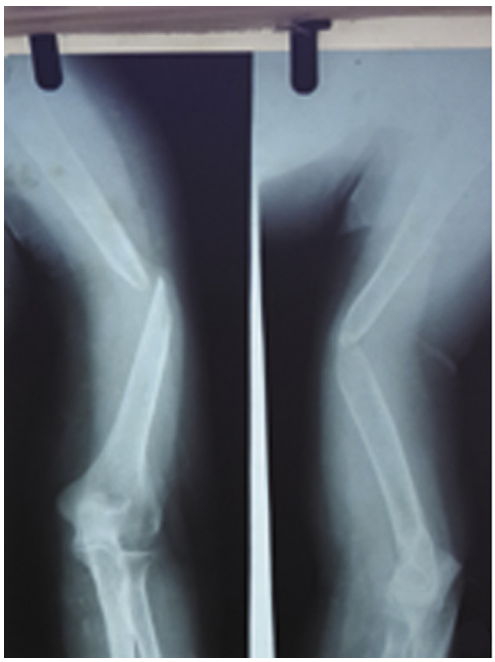

Fig. 1. Nonunion in an extremely porotic humerus. The thin cortices can be appreciated.

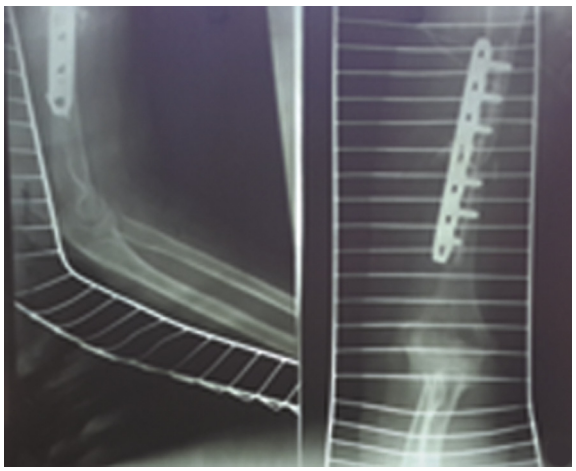

Fig. 2. Postoperative radiograph showing the intramedullary fibula with locking plate fixation.

Discussion

Nonunion of long bones is likely to be related to the severity of initial injury, transverse pattern of fracture, or soft-tissue interposition. Failure to unite after surgical treatment may be due to poor contact between the bone ends, inadequate stabilization, devitalization of bone, osteopenia, and bone defects. Obesity, alcoholism, and method of treatment may also be contributory factors.[5]

The lack of mechanical stability due to a flail arm may interfere with personal hygiene, dressing, and simple activities of daily living. The goal of surgery is to achieve a stable fixation and institute early mobilization of stiff joints. Humeral nonunion in osteoporotic bone presents a reconstructive challenge for the treating orthopaedic surgeon.[8] While a number of methods of managing atrophic fracture nonunion have been suggested, each has its drawbacks. Most surgeons favour the use of an interlocking nail, Ilizarov external fixator, or locking compression plate (LCP) for stabilization and vascularised fibular graft or cancellous iliac crest bone graft for enhancement of fracture union.[9]

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